

**WHY ELECTRICAL
PREVENTIVE
MAINTENANCE IS
ESSENTIAL TO A
SAFE AND
PRODUCTIVE
WORKPLACE**

AGENDA

SCRWA 14 SEPTEMBER 2016

- Definition
- Why EDPM is essential to productivity
 - Fiscal sustainability
- Why EDPM is essential to safety
 - NFPA 70E
- A longer view
 - Root cause analysis
 - IPF curve
- Best practices
- Summary

Definition of Preventative Maintenance

Preventative maintenance (or preventive maintenance) is maintenance that is regularly performed on a piece of equipment to lessen the likelihood of it failing.

Preventative maintenance is performed while the equipment is still working, so that it does not break down unexpectedly.

Items We have Maintenance On



Why our office equipment?



Why our data centers?



Why our UPS equipment?

Why our generators?



Why our material handling equipment ?



Why our production equipment ?





Why fire extinguisher maintenance?



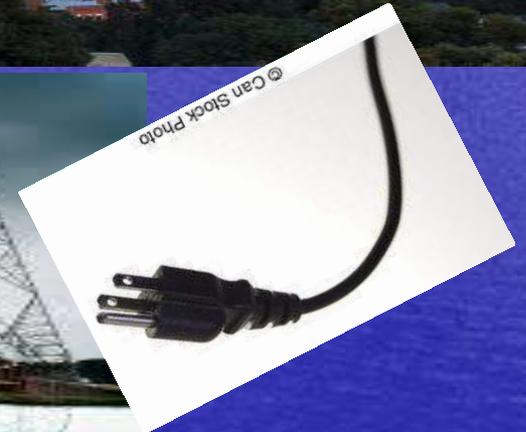
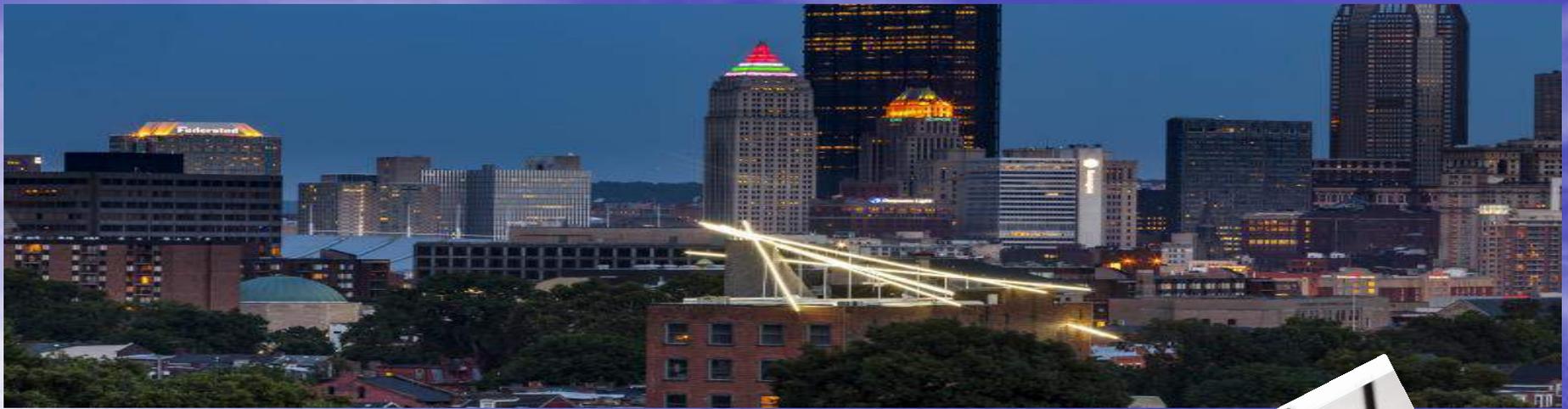
Why exit signs / lights maintenance?

Why HVAC / boiler maintenance?



Why have all of the other Preventative

**Maintenance programs,
and the cost associated
with them, if you don't have a
preventative maintenance
program on the plug or the
electrical distribution system?
Without electricity, all other maintenance
programs are worthless when the
equipment has no power.**



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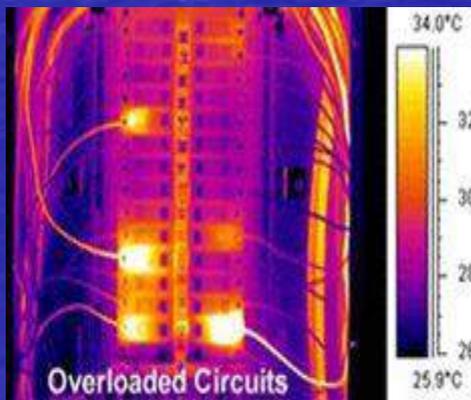
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2 atoms are walking down the street.....

- One says to the other, 'I lost an electron'
- The other says, 'are you sure?'
- First one answers, 'yes, I'm positive'

Why The NFPA 70-E standard exists and its requirement for Electrical Preventative Maintenance





WARNING



4,700

APPROXIMATELY 4,700 INJURIES ARE REPORTED EVERY YEAR IN THE U.S. AS A RESULT OF WORKING ON OR AROUND ELECTRICITY.



ONE



ELECTRICAL ACCIDENTS ARE ALSO BLAMED FOR AN AVERAGE OF ONE DEATH PER DAY, EVERY DAY, IN THE WORKPLACE.



OSHA HAS DUBBED ELECTRICAL HAZARDS ONE OF THEIR "FATAL FOUR" VIOLATIONS FOUND IN WORKPLACES.



\$116,280

Babcock & Wilson fined a total of \$116,280, including one citation for "allowing workers to be close to an energized electrical panel, therefore exposing them to arc flash and blast hazards."



\$133,000

Theford Construction Co., Inc. fined a total of \$133,000, including a citation for "failing to ensure that workers do not approach energized electrical equipment closer than 2 feet."

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

ELECTRICAL HAZARD ISSUES ARE THE 9TH MOST CITED VIOLATIONS BY FEDERAL OSHA INSPECTORS.

OSHA'S General Duty Clause:

Section 5(a)(1) of the Occupational Safety and Health Act requires an employer to furnish to its employees: employment and a place of employment

which are free from recognized hazards that are causing or likely to cause death or serious physical harm to its employees

NFPA 70E Article 110 General Requirements for Electrical Safety-Related Work Practices

110.1 Electrical Safety Program

(A) General : The employer shall implement and document an overall safety

program that directs activity appropriate to the risk associated with electrical

hazards. The electrical safety program shall be implemented as part of the

employer's overall occupational health and safety management system, when one exists.

6 Point Compliance Checklist

- 1. Maintain an updated NFPA 70E safety plan***
- 2. Train and qualify employees in NFPA 70E compliance***
- 3. Generate, update and post a single-line diagram***
- 4. Perform Arc Flash Risk Assessment then apply Arc Flash labels***
- 5. Provide employees with Personal Protective Equipment (PPE)***
- 6. Electrical Predictive and Preventive Maintenance per NFPA 70B***

Upcoming NFPA 70E Qualification Training

- October 4-5, 2016
- At Shealy Electrical Wholesalers,
Columbia
- NFPA Certified Trainer, experienced
in EDPM & EDPdM
- Registration is open at
NFPA.TEGG.com

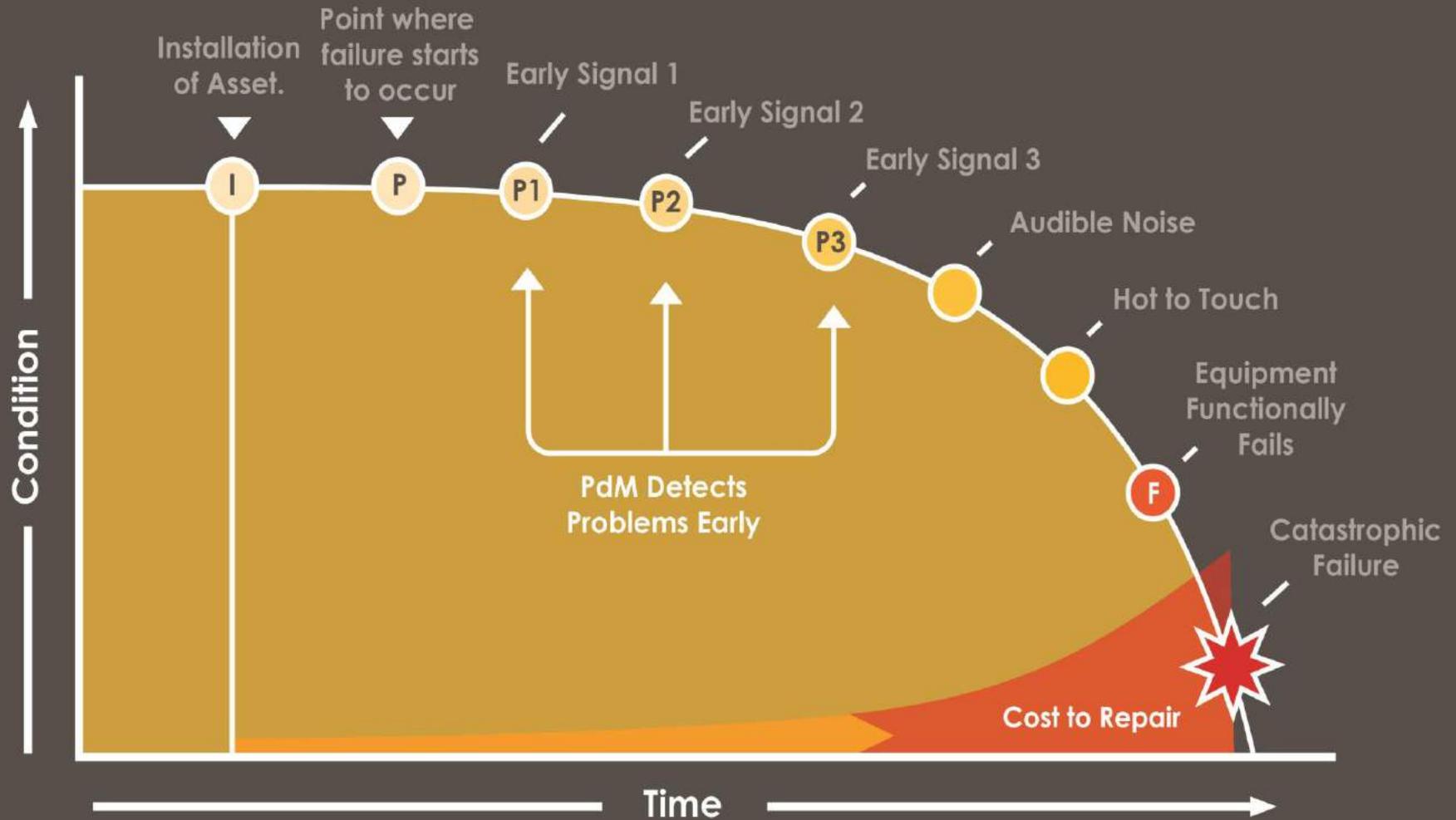
**Many of us have
reached an age,
ironically...**

...when we now see things further
out, a longer horizon if you will.
So let's talk about missions rather
than tasks, strategies rather than
tactics...

The Second Law of Thermodynamics

- In a natural thermodynamic process there is an increase in the sum of the entropies of the participating systems
 - Without the application of counterbalancing energy, all systems and nodes (devices) move constantly from organized to disorganized, from birth to death

I to P to F Curve

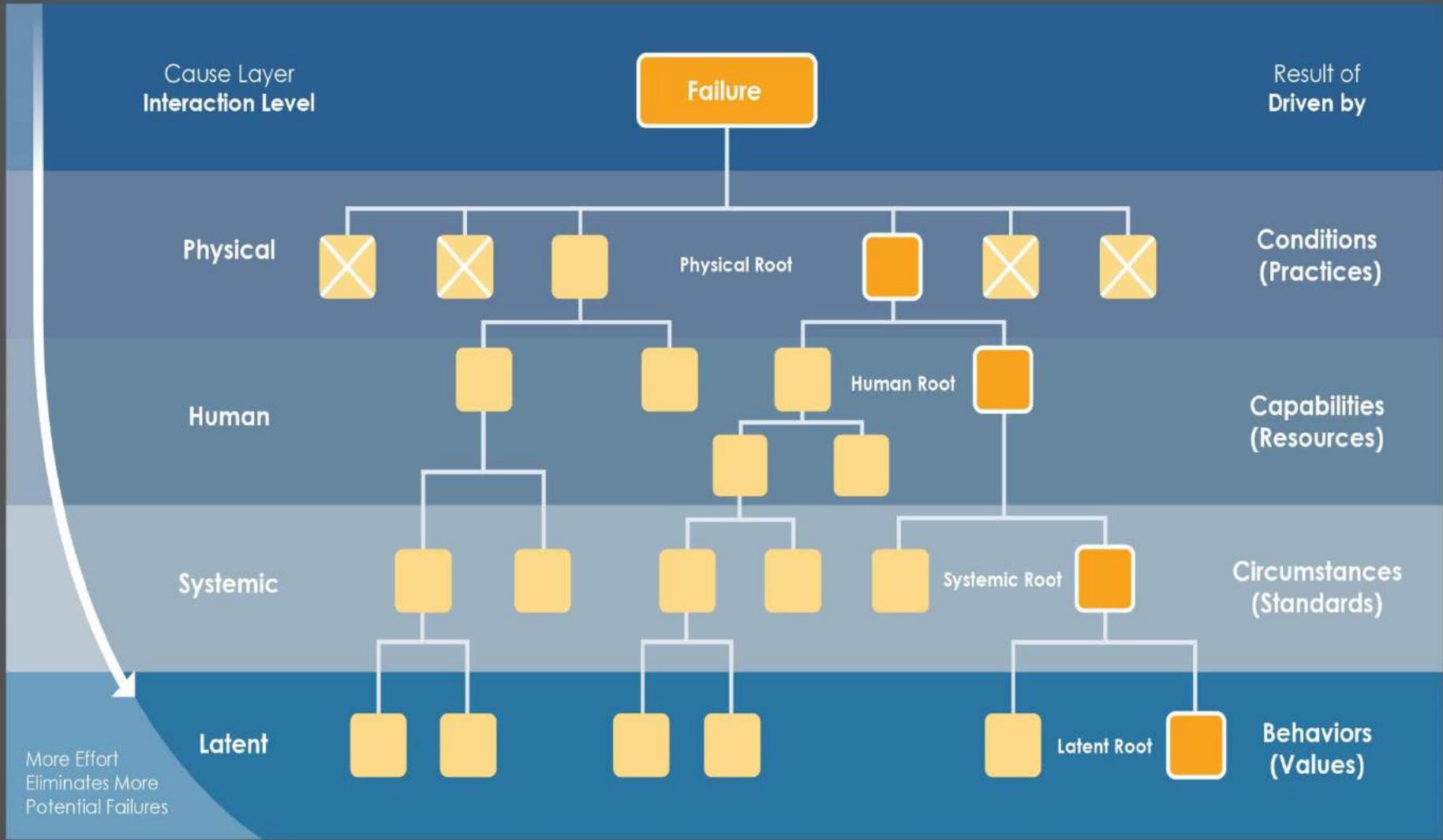


A word on Fiscal Sustainability

(Thank you Jill Miller and Mike Bailes)

- 2014 WRRDA & CWSRF and aging infrastructure
 - Asset inventory – what, where, value, condition, remaining life
 - How and when will assets fail, probabilities and consequences
 - Lifecycle of current assets, cost to repair, rehabilitate, or replace

Root Cause Analysis



Improving Asset Management Effects on Bottom Line

RESULTS ABERDEEN GROUP SIGMA RELIABILITY STUDY			
	LOWER QUARTILE PERFORMERS	AVERAGE PERFORMERS	UPPER QUARTILE PERFORMERS
AVAILABILITY	81.8	87.2	88.8
YIELD	79.2	81.9	84.2
MAINT COSTS/SALES	23.5	20.8	17.2

INCOME STATEMENT			
SALES	1,000,000,000	1,102,356,079	1,154,108,320
COSTS			
COGS (assume 60%)	600,000,000	661,413,647	692,464,992
MAINTENANCE COSTS	235,000,000	229,290,064	198,506,631
FIXED COSTS	100,000,000	100,000,000	100,000,000
TOTAL COSTS	935,000,000	990,703,711	990,971,623
EBITDA	65,000,000	111,652,368	163,136,697
EBITDA AS % OF LOWER QUARTILE PERFORMERS	100%	172%	251%

Guide to Fuse Replacement

copious amounts
of finfall



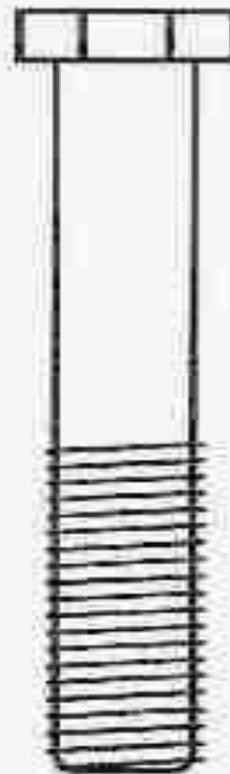
97 amp



243 amp

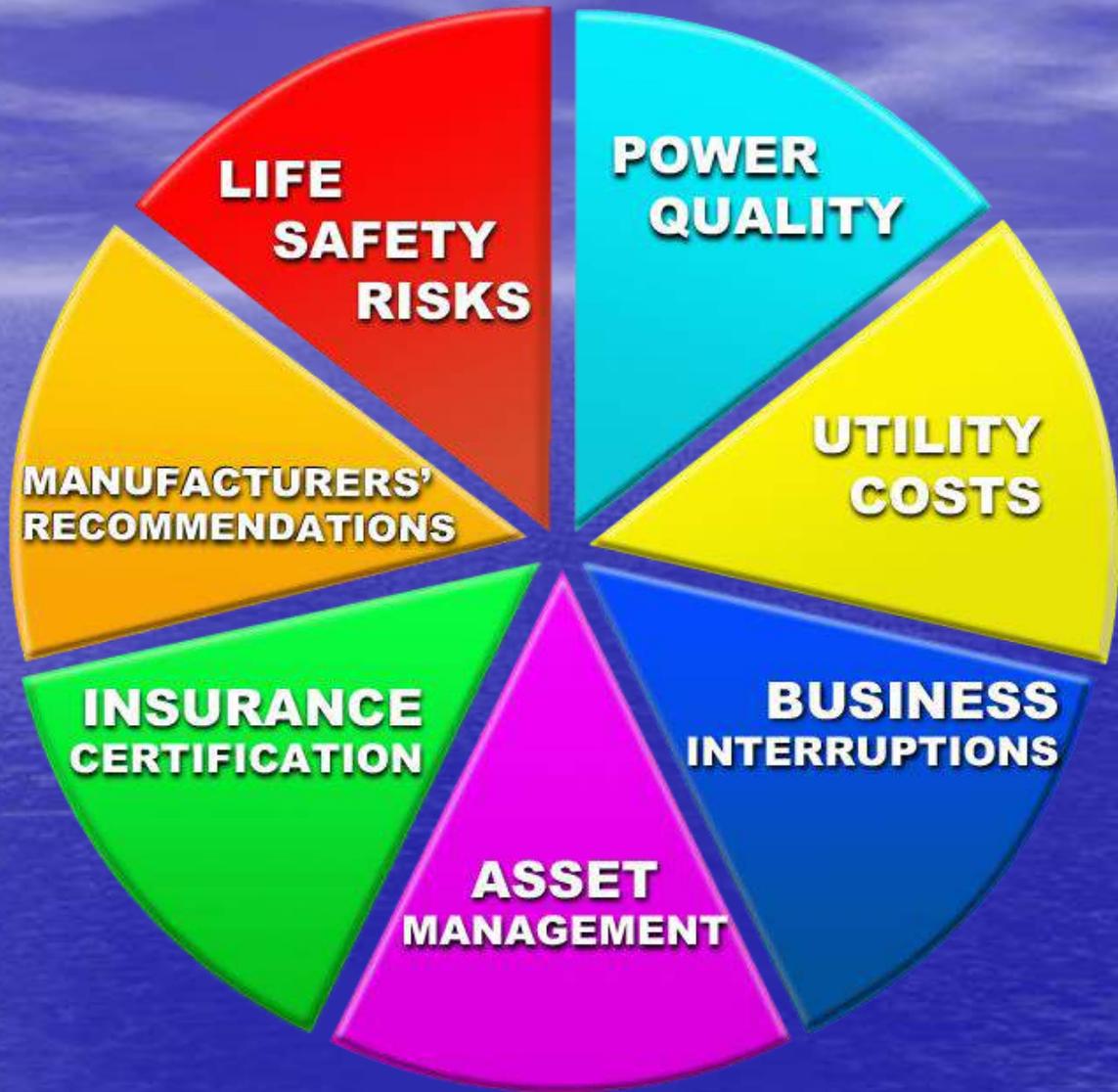


612 amp



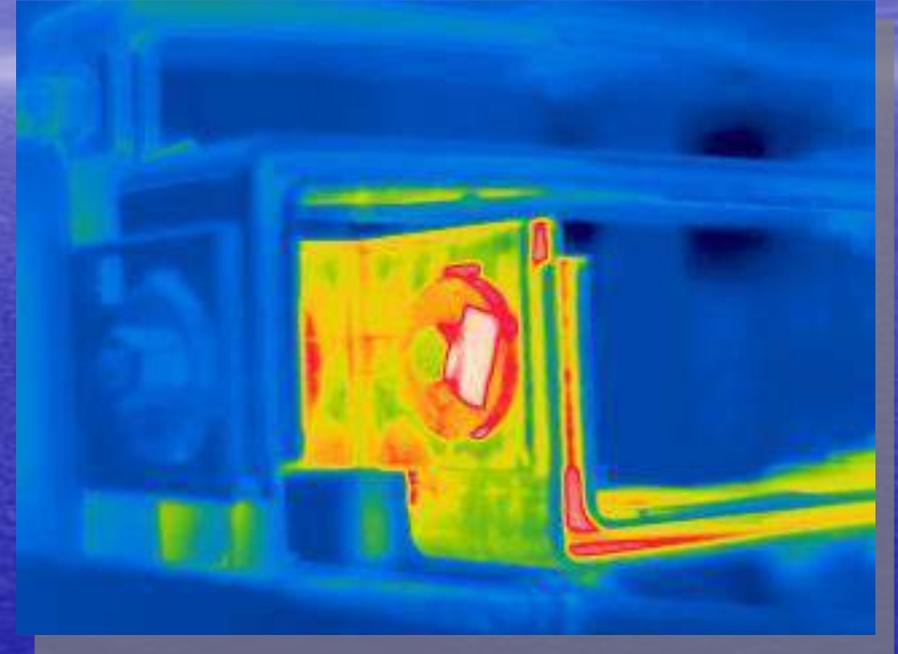
1482 amp
(Slow-Blow)

Why We Do It





INFRARED TECHNOLOGY



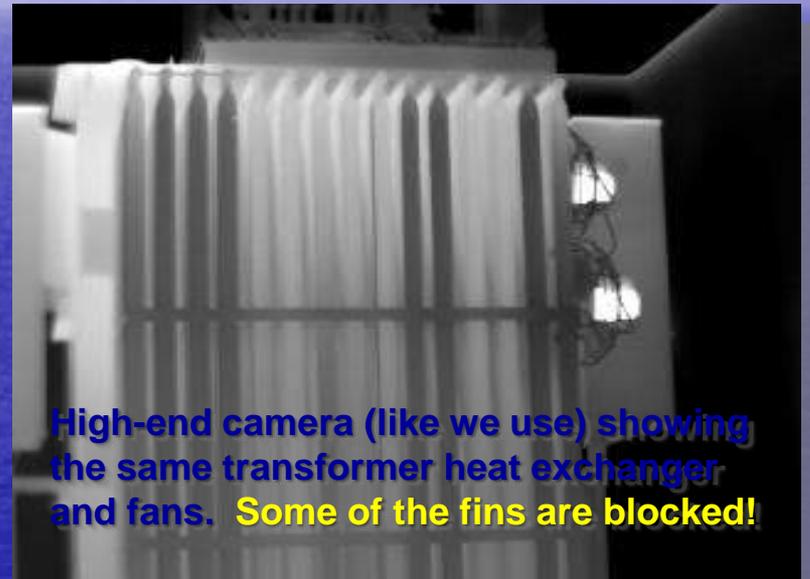
Example of a high resistance electrical connection.

Def. Infrared: Light waves just outside the visible spectrum, that is, waves slightly longer than those visible to the human eye.





INFRARED TECHNOLOGY



Low-end cameras have lower resolution, which means potential costly problems are less likely to be identified!

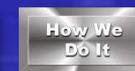
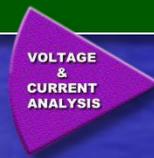




INFRARED TECHNOLOGY

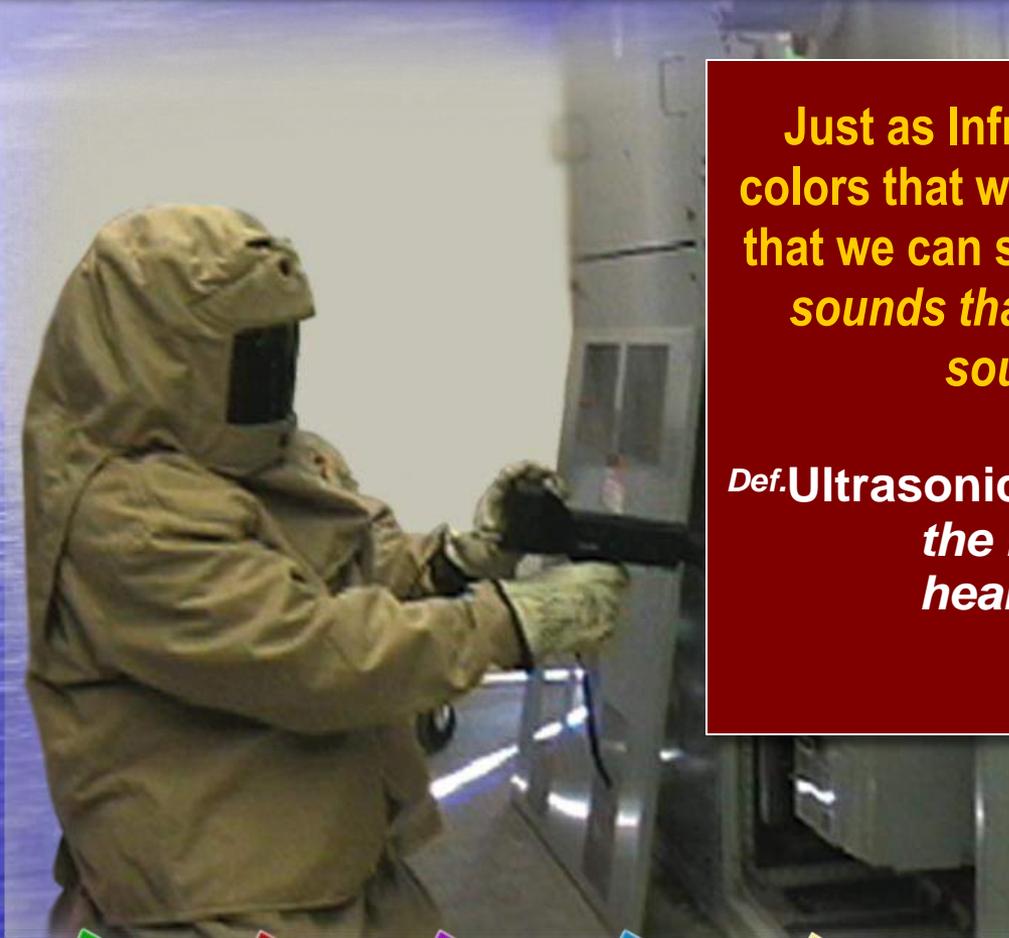


- ✓ Safety permitting, all covers must be removed to provide a direct line-of-sight to electrical connections.
- ✓ The person removing covers and 'dead fronts' must be QUALIFIED and familiar with the construction & hazards of the equipment.
- ✓ He/she also MUST wear the appropriate arc flash and shock protective equipment based on the risk associated with the task.



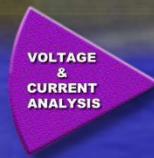


ULTRASONIC TESTING



Just as Infrared Thermography converts colors that we can't normally "see" to colors that we can see, *Ultrasonic Testing* converts sounds that we can't normally "hear" to sounds that we can hear.

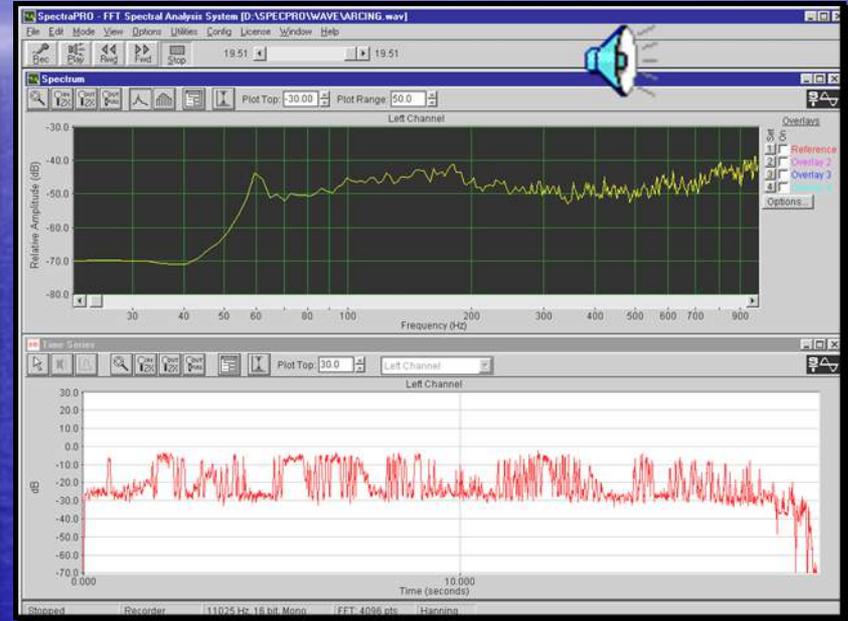
Def. Ultrasonic: Having frequencies above the normal range of human hearing, i.e., higher than ~20kHz.





ULTRASONIC TESTING

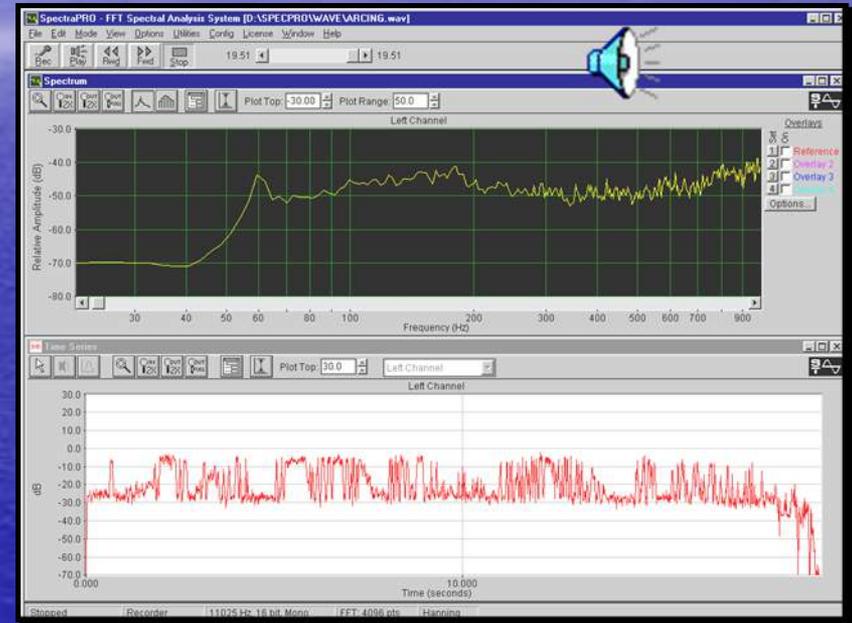
“Ultrasound will hear arcing in circuit breakers, switches, contacts and relays. In most instances, a quick scan of a door seal or vent will detect the ultrasound emission.”





ULTRASONIC TESTING

“Destructive corona has a build up and drop-off of energy resulting in a buzzing sound accompanied by subtle popping noises.”





VISUAL INSPECTION

Examples of Code Concerns



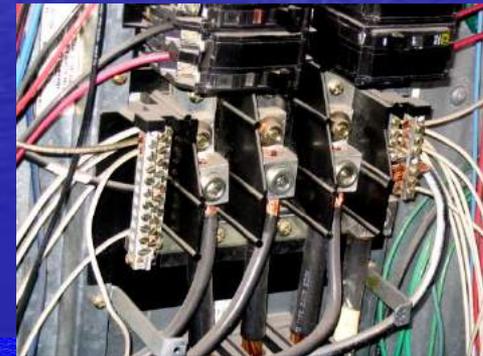
Missing bushings can cut insulation.



Missing knockouts and fuse storage.



Inadequate working space.



'Double Lugging'



Transformer Oil Sampling provides great Intel on the condition of the transformer

IFT: test measures the presence contaminants and oxidation products

Acid Number: the acid neutralization number is a measure of the amount of acid materials present in the oil. As the transformer ages, the oil will oxidize and increase in acidity

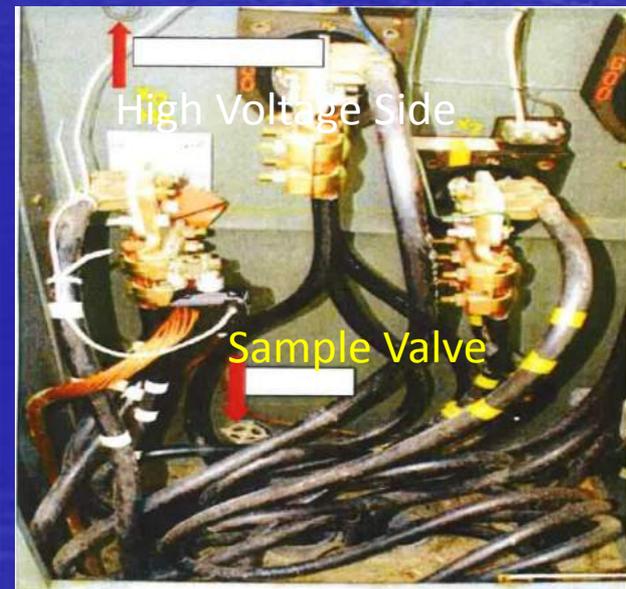
Oil Moisture: test measures water within the transformer oil

Power Factor: the power factor test measures the dielectric losses of the oil, or energy that is dissipated as heat

Dielectric Breakdown Voltage: the dielectric test measures the ability of the oil to withstand electric stress without failure

Dissolved Gas Analysis: the DGA test measures various gas levels that indicate various types of thermal and electrical stress occurring within the transformer

Oil Color: the color test is a simple test that indicates oil quality. The higher the color number is, the higher the probability of contamination or deterioration





All Manufacturers of Electrical Equipment recommend a yearly maintenance schedule outlined by IEEE, FM Global, NETA, NFPA 70-E and NFPA 70-B

Breaker testing recommendations are as follows:

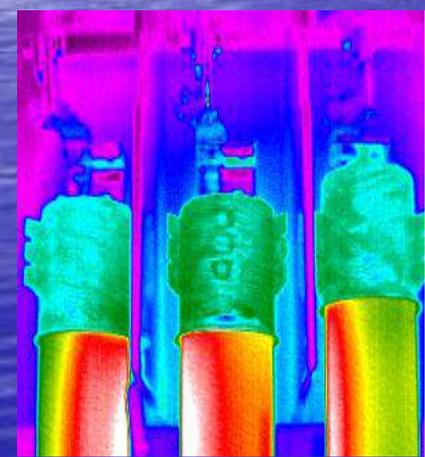
- The breaker must be exercised, visually inspected, cleaned, and lubrication applied to all moving parts.
- Secondary injection is required every three years and is the testing of the breakers trip functions to ensure the breaker will perform as designed in case of a fault.



Typical Primary Injection



IR Windows allow the maintenance team to perform IR testing of high voltage equipment without the risk and liability of opening energized electrical equipment



Summary

- Without reliable electricity, nothing else works
- OSHA considers electrical hazards one of the fatal four violations in the workplace
- Organize strategies, change your culture to increase reliability and safety, improve fiscal sustainability, and reduce maintenance costs